Proposal for 2010 - 2011
Northwest Columbia Plateau PM_{10} Project

Objective 7: **Identify Sustainable Farming Practices for the Columbia Plateau by Measuring Changes in Soil Quality**

Title: ***The Effect of Wind Erosion and Control Measures on Soil Carbon, Communities and Quality***

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Project Objectives

Our overall objective is to determine the effect of wind erosion and management practices on soil organic matter, soil biological communities and soil quality characteristics. The first objective of this research is to characterize biological, physical and chemical soil quality parameters and monitor their changes over time in tillage systems of dryland farming systems. Our second objective is to quantify the carbon content and biological fingerprints found in wind-eroded sediments from agricultural soils. Our third objective is to evaluate residue traits of fiber components, nutrient content, and tannin content of cultivars of spring wheat, winter wheat and spring barley.

Recent Accomplishments

Our overall objective is to determine the effect of wind erosion and management practices on soil organic matter, soil biological communities and soil quality characteristics. The first objective of this research is to characterize soil quality and monitor changes over time in dryland farming systems. Soil organic carbon is slowly increasing in long-term no-till and approaches or exceeds that of nearby undisturbed sites. Long-term no-till also increased the proportion of aggregates in the larger sized soil fractions. No-till soils store a greater proportion of the carbon in the larger size aggregates, thus protecting more of the carbon from loss due to wind erosion. At Lind, WA, the soil quality of continuous winter wheat-burn-plow treatment is being degraded compared to direct seed treatments, no matter how the residue was handled. In a long-term no-till drill study we found no differences in the soil properties tested in these two sites. Our second objective is to quantify the carbon content and biological fingerprints found in wind-eroded sediments from agricultural soils. We are investigating the carbon content and biological fingerprint of fractions of agricultural soil collected in Big Spring Number Eight (BSNE) sample collectors. We found that the carbon content of agricultural soil collected in BSNE sample collectors were either the same as or greater than the carbon content of surrounding bulk soil. Carbon values were similar at all collection heights. We also found that the biological fingerprint of the suspended material was somewhat different from the bulk soil. These results indicate that soil from up-wind sites were also collected on these samplers. Our third objective is to evaluate residue traits of fiber components, nutrient content, and tannin content of cultivars of

spring wheat, winter wheat and spring barley. We found that fiber components and nutrient content varied by location, precipitation zone, and cultivar. Residue in the drier year of the study had lower fiber, C, and C:N ratio. Foot-rot (*Fusarium* spp.) resistant winter wheat cultivars had higher fiber levels than susceptible cultivars. We are developing near-infrared spectroscopy (NIRS) as a rapid, non-destructive, chemical-free method to predict residue fiber and nutrient content. Fiber and nutrient characteristics of residue from wheat and barley cultivars currently produced in the Pacific Northwest can be used to predict residue decomposition in cropping systems that conserve soil and water, and enhance build-up of soil organic matter.

Planned Research

Objective 1. Characterize biological, physical and chemical soil quality parameters and monitor their changes over time.

Research will be conducted in conjunction with the ongoing wind erosion projects at various locations. Soil samples will be collected annually to characterize soil quality. Soils will be incrementally sampled from the 0 to 10 cm depth in early spring and mid-summer to monitor soil quality changes over time (Table 1). For each treatment, four replications will be taken with seven subsamples bulked per replication. Soil quality and crop production data will be used to assess the influence of management practices on these parameters.

The soil properties to be analyzed include bulk density; soil pH (1:1 ratio of soil:water); electrical conductivity; organic C and N (Leco Analyzer); and aggregate size distribution. Nutrient cycling and N movement with depth are being followed with periodic samplings and subsequent analysis for inorganic nitrogen and organic carbon (Hart et al., 1994). The soil microbial constituents of various management systems will be assessed by several different microbial methods. A study of the microorganisms in the selected plots involves soil biomass, respiration and dehydrogenase enzyme activities (Tabatabai, 1994). Soil from each of the cropping systems will be analyzed using phospholipid fatty acid (PLFA) and fatty acid methyl ester (FAME) analyses (Kennedy and Busacca, 1995) to determine microbial community structure and effects of stress on the system (Ibekwe and Kennedy, 1998). The statistics to be used include analysis of variance (ANOVA) using Tukey's test and Principal Component Analysis (Steel et al., 1997; SAS, 1999).

Objective 2. Quantify the carbon content and biological fingerprints found on wind-eroded sediments from agricultural soils.

We have been investigating the carbon content and biological fingerprint of fractions of agricultural soil collected in BSNE (Big Spring Number Eight) sample collectors and we will continue to do so. This year we will also investigate the composition of other air samplers. We propose to determine the amount of organic C lost to wind erosion and the impact of type of wind event, location and management on this loss. Along with the carbon content we are also interested in determining the biological fingerprint of the suspended material. We will use biological fingerprinting to determine the microsite or microaggregate origin of particles that are more erodible than others. We will utilize particulate matter collected in air samplers adjacent to conventionally and conservation-tilled agricultural fields, as well as characterize bulk soil and aggregates. Brenton Sharratt has provided samples that were collected over a ten year period. These samples are from various wind events at several different locations have been collected in 0.1, 0.2, 0.5, and 1.0 m increments to 1.5 m. The soil properties to be analyzed include total C

and N (Leco Analyzer); and fatty acid methyl ester (FAME) analyses (Kennedy and Busacca, 1995) to determine soil biological community structure.

Data will be analyzed by one-way ANOVA analysis using Tukey's test or a multiple ANOVA (MANOVA, SAS, 1999). We will determine those characteristics that separate the samples from one another and from the bulk soil. We will also calculate the amount of carbon lost from fields and determine the changes in the soil community markers of the suspended particulate material.

Objective 3. Evaluate residue traits of fiber components, nutrient content, and tannin content of cultivars of spring wheat, winter wheat and spring barley.
Cultivars of winter wheat, spring wheat, and spring barley will be chosen based on use, success in variety trials, lineage, foot rot response (winter wheat) and perceived decomposition in the field. Residue will be sampled from replicated plots in Washington. Nurseries will be grown under the same management (tillage, planting, fertilization, weed control) as the location/cooperator. Samples will be dried, and internode stem samples will be collected and ground to pass a one-mm sieve. Residue will be analyzed for total C, N, S, hemicellulose, cellulose and lignin content. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents will be determined using a modification of the Goering and VanSoest (1970) procedure. Samples will be analyzed using a LECO TruSpec CN Elemental Determinator (LECO Corp., St. Joseph, MI) to determine total C, and N and calculate C/N ratios. For the NIRS analysis ground samples are enclosed in stationary metal ring cups (36 mm inside diameter) and reflectance determined by scanning with a FOSS XDS Rapid Content Analyzer (Foss NIRSystems, Laurel, MD) using ISIscan software, version 3.10 (Infrasoft International, State College, PA) and wavelength range 400 to 2,498 nm at 2 nm intervals. Calibration and validation statistics will be conducted using the WinISI software, version 4.0 (Infrasoft International, State College, PA). Phenolics in crop residue will be determined using the procedure of Hagerman (2002). Total phenolics will be determined using the modified Prussian Blue assay of Graham (1992) using absorbance at 700 nm and gallic acid as the standard.

Data will be analyzed by one-way ANOVA analysis using Tukey's test and a multiple ANOVA (MANOVA, SAS, 2009). We will determine those characteristics that separate the cultivars from one another and correlate the fiber and nutrient characteristics with residue decomposition.

Table 1. Soil quality parameters proposed for analysis.
(Not all analyses will be conducted at all sites)

PHYSICAL	**BIOLOGICAL**
Aggregation	Residue cover estimate
Bulk density	Straw to grain ratio
Depth to hardpan	Microbial activity (enzymes)
Surface residue	Dehydrogenase
Surface condition	*B*-Glucosidase
Water holding capacity	*B*-Glucosaminidase
	Microbial biomass
	Microbial community
CHEMICAL	Fatty acid analysis
Soil organic matter	Phospholipid fatty acids
Soil carbon fractions	Substrate utilization
Electrical conductivity	Nitrogen cycling
pH	Microbial respiration
Nutrients	Available C

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